WHY AIRPORT DRAINAGE?

An adequate drainage system is required

1. for the removal of surface and subsurface water.
2. for the safety of aircraft and for the longevity of the pavements.
3. for interception and diversion of surface and groundwater flow originating from lands adjacent to the airport

The purpose of drainage is to reduce the amount of water entering the soil and to maintain a firm, stable, and reasonably dry surface for the safe use by the aircraft

For the safety of take-off and landing, the surface of paved runways should be free from water.

Improper drainage results in the formation of puddles on the pavement surface, which can be hazardous to aircraft taking off and landing.

OBJECTIVES OF DRAINAGE

1. To protect airport territory against inflow of surface water coming from adjacent catchment basins.
2. To collect surface water from natural depression.
3. To dispose the collected water by removing it beyond airport boundary.
4. To lower the water table if necessary.
5. To remove excessive water from pervious bases of pavements.

INTERCEPTION OF SURFACE AND GROUND WATER

To maintain a firm, stable, and reasonably dry surface for the safe use by aircraft, an airfield must be protected against **flooding**, **underflooding** , or **both**.

The principal structures providing protections against flooding and under flooding are:

1. Catch water
2. Intercepting channels
3. Intercepting drains/Bank drains
4. Dykes.

SURFACE AND SUBSURFACE DRAINAGE OF PAVED AREAS

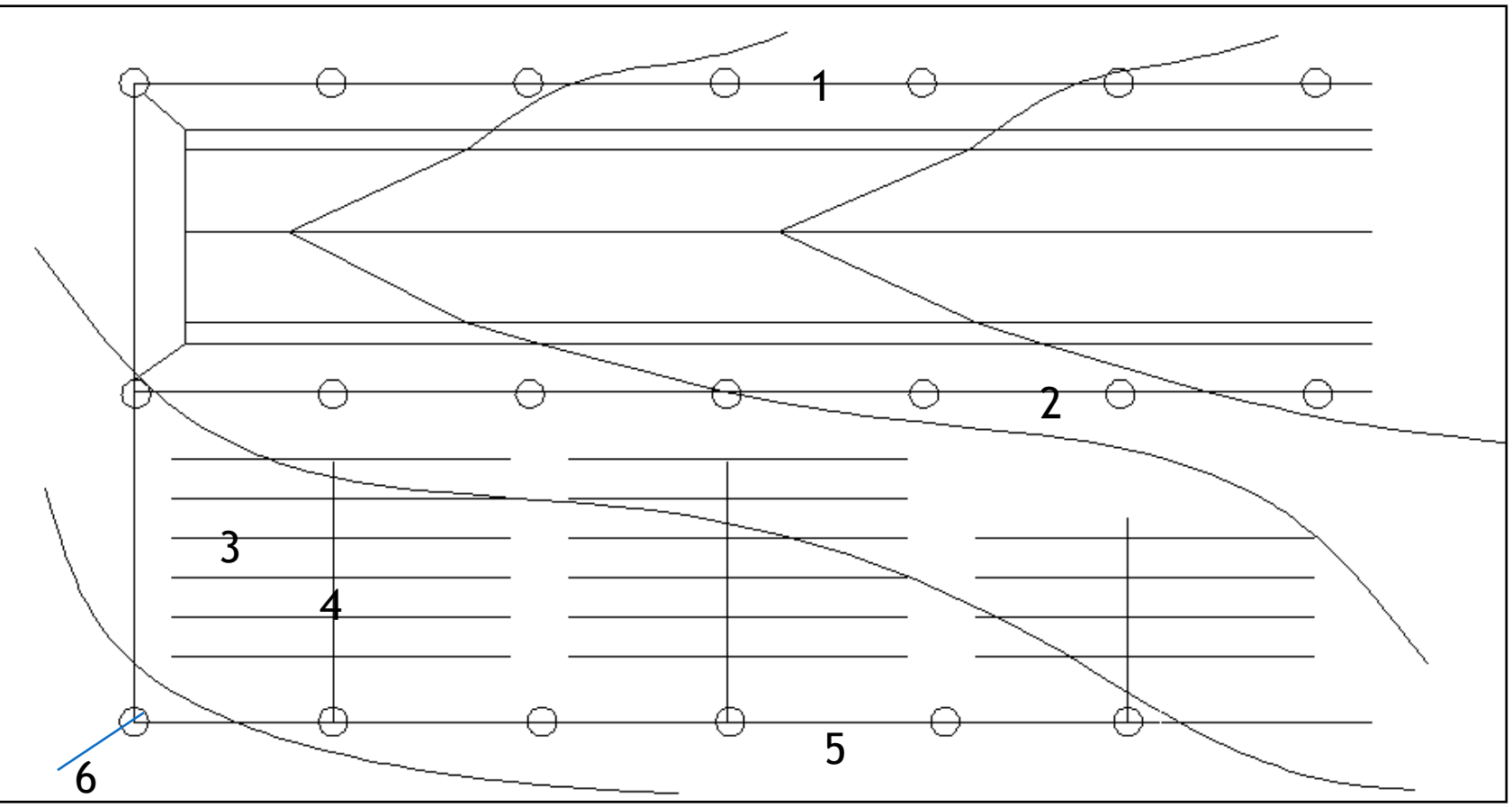
To avoid the unnecessary phenomena (reduction in bearing capacity of subgrade and erosion of unpaved area) due to drainage problem we have to consider following:

1. Choose the runway, taxiway, apron and parking areas that would give the best in surface drainage.
2. Provide adequate longitudinal and transverse gradient for airport pavement and unpaved shoulder.
3. Raise the pavement edge above the ground.
4. Build the impermeable pavements.
5. Provide appropriate surface and subsurface drainage .

The artificial surface and subsurface drainage installed facilitate to:

- Collect and dispose of surface water running off high ground to paved runways, taxiways, parking areas, and aprons,
- Collect and dispose of surface water running off the pavements and shoulders,
- Collect and dispose of water accumulating in pervious soil foundations'
- Remove water from natural depressions in the immediate vicinity of paved areas.

LAYOUT OF SUB DRAIN NETWORK



1, 2- Main drain 3- Lateral drain 4- Collector drain 5- Main drain

6- Outfall drain

ELEMENTS IN THE SYSTEM

1. Drawn scale 1:5000
2. Airfield boundary
3. Outlines of paved areas
4. Final grade contours
5. Location of surface and sub surface drainage facilities like feeder drains, collectors drains, main drains, crossover pipes, field and pavement storm water inlets, man holes, catch waters, intercepting drains, and so on.
6. No of various drainage structure and pipe diameter and lengths.

ELEMENTS IN THE SYSTEM …

7. Description and characteristics of adopted system.
8. Initial data for hydraulic analysis of conduits.
9. Drawing of components.
10. Volumes of work and bills of materials.
11. Cost estimates for purposed surface and subsurface drainage structure.

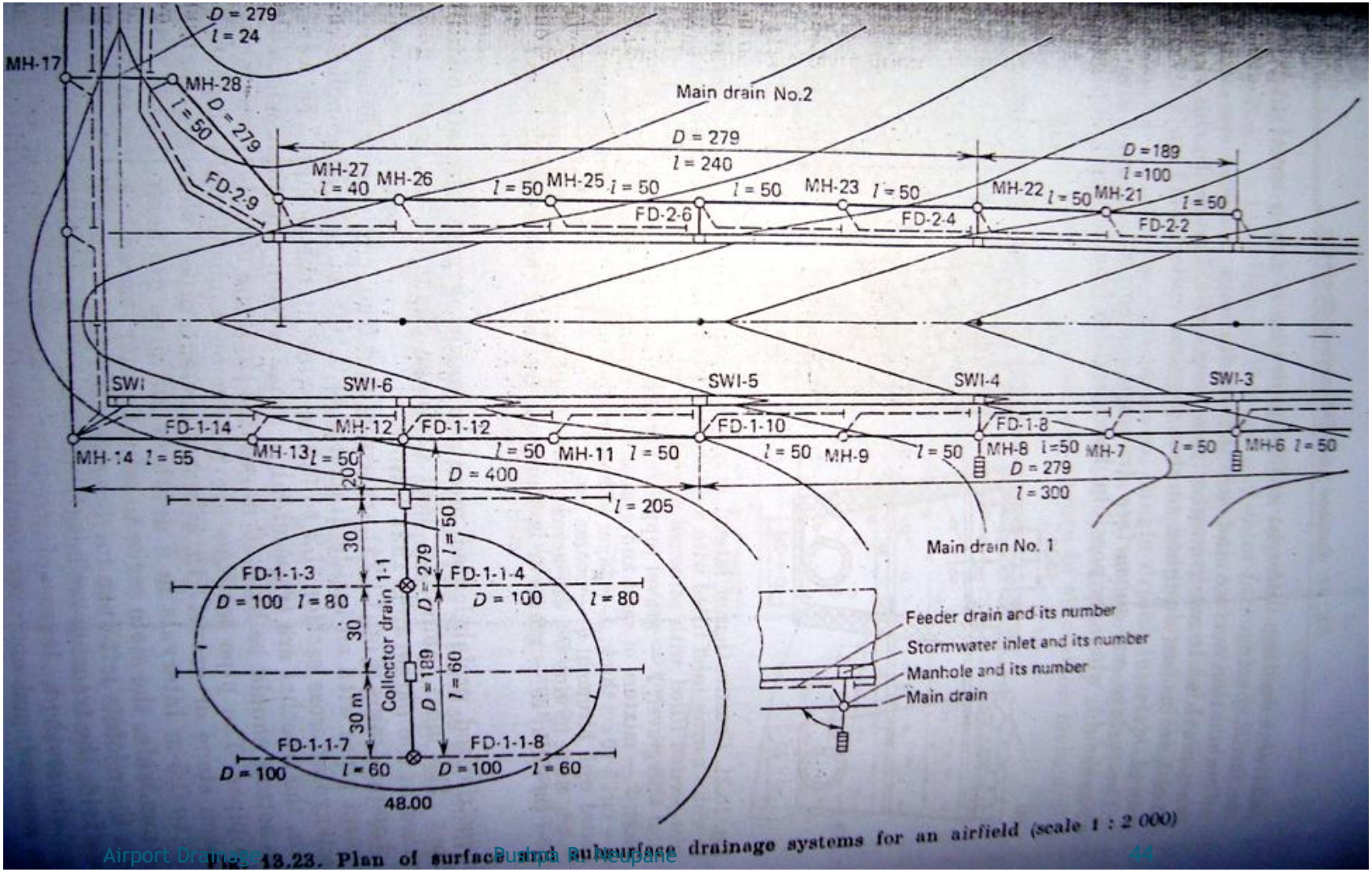


Fig. 13.23. Plan of surface and subsurface drainage systems for an airfield (scale 1 : 2 000)

Determining the Amount of Runoff by the FAA Procedure

The FAA analysis of airport surface drainage revolves about the solution of the *rational method* expression

$$Q = CIA \tag{9-1}$$

where Q = runoff from given drainage basin, ft^3/s
C = ratio of runoff to rainfall
I = rainfall intensity for time of concentration of runoff, in/h
A = drainage area, acres

Examples and charts illustrating the FAA procedure for design have been taken largely from the FAA [2].

Time of Concentration

The *time of concentration* is defined as the time taken by water to reach the drain inlet from the most remote point in the tributary area. The *most remote point* refers to the point from which the time of flow is the greatest. The time of concentration is usually divided into two components: inlet time and time of flow. The *inlet time* is the time required for water to flow overland from the most remote point in the drainage area to the inlet. The *time of flow* is the time taken by the water to flow from the drain inlet through the pipes to the point in the system under consideration. Sometimes the inlet time will be the time of concentration; at other times the time of concentration will be the sum of the inlet time and time of flow.

The time of flow can be computed by the use of well-established hydraulic formulas. The inlet time is obtained largely empirically from the relationship

$$D = kT^2 \tag{9-2}$$

Where D = distance, ft
T = time, min
k = dimensional empirical factor which is dependent on slope, roughness of terrain, extent of vegetative cover, and distance to drain inlet

Coefficient of Runoff

Application of the rational method requires the exercise of considerable judgment on the part of the engineer. The runoff rate is variable from storm to storm and varies even during a single period of precipitation. The coefficient of runoff depends on antecedent storm conditions, slope and type of surface, and extent of the drainage area. The range of values suggested by the FAA is indicated in Table 9-1.

For drainage basins consisting of several types of surfaces with different infiltration characteristics, the weighted runoff coefficient should be computed in accordance with

$$C = \frac{A_1C_1 + A_2C_2 + A_3C_3}{A_1 + A_2 + A_3} \tag{9-3}$$

Types of Surfaces	Factor C
For all watertight roof surfaces	0.75–0.95
For asphalt runway pavements	0.80–0.95
For concrete runway pavements	0.70–0.90
For gravel or macadam pavements	0.35–0.70
For impervious soils (heavy)*	0.40–0.65
For impervious soils with turf*	0.30–0.55
For slightly pervious soils*	0.15–0.40
For slightly pervious soils with turf*	0.10–0.30
For moderately pervious soils*	0.05–0.20
For moderately pervious soils with turf*	0.00–0.10

*For slopes from 1 to 2 percent.
Source: Federal Aviation Administration [2].

TABLE 9-1 Coefficients of Runoff C

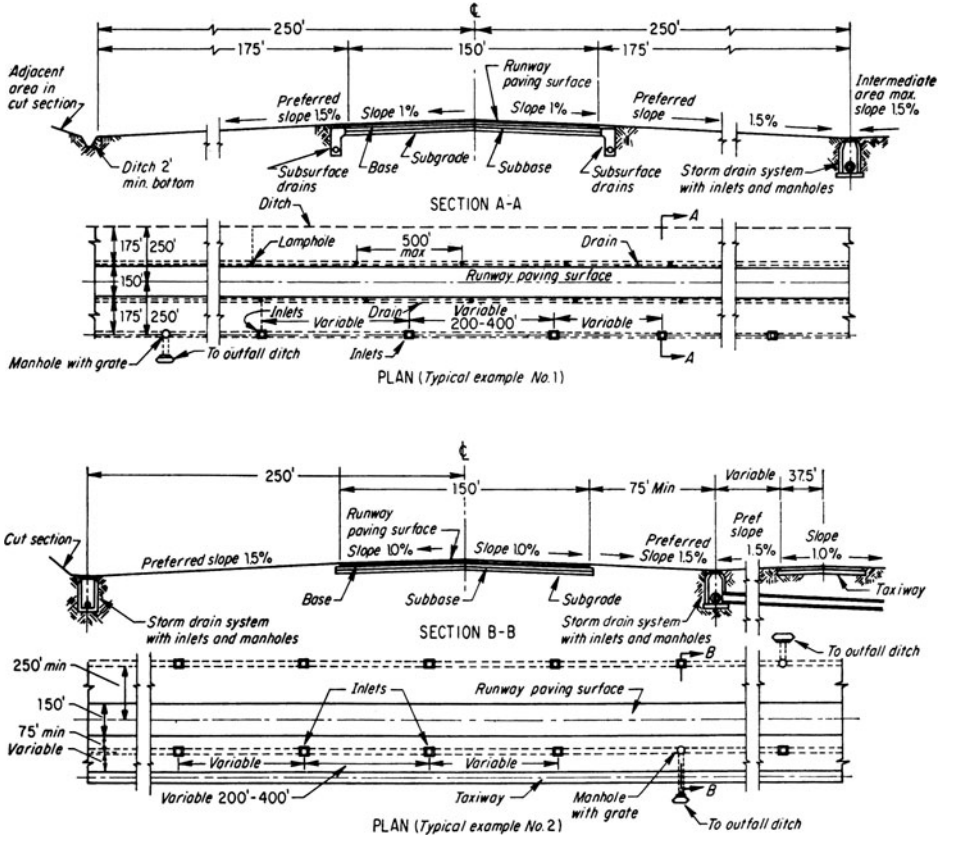


FIGURE 9-14 Recommended pavement drainage sections (*Federal Aviation Administration [2]*).

Subsurface Drainage

The functions of subsurface drainage are to (1) remove water from a base course, (2) remove water from the subgrade beneath a pavement, and (3) intercept, collect, and remove water flowing from springs or pervious strata.

Base drainage is normally required (1) where frost action occurs in the subgrade beneath a pavement, (2) where the groundwater is expected to rise to the level of the base course, and (3) where the pavement is subject to frequent inundation and the subgrade is highly impervious.

Subgrade drainage is desirable at locations where the water may rise beneath the pavement to less than 1 ft below the base course.

Intercepting drainage is highly desirable where it is known that subsurface waters from adjacent areas are seeping toward the airport pavements.

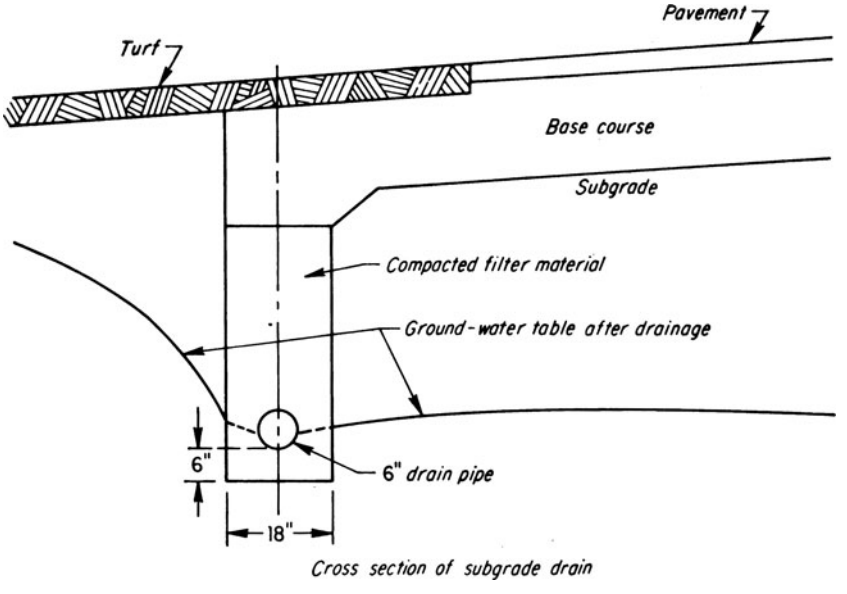


FIGURE 9-15 Subgrade subdrainage details (*Corps of Engineers*).

Methods for Draining Subsurface Water

Base courses are usually drained by installing subsurface drains adjacent to and parallel to the edges of the pavement. The pervious material in the trench should extend to the bottom of the base course, as shown in Fig. 9-15. The center of the drainpipe should be placed a minimum of 1 ft below the bottom of the base course.

Subgrades are drained by pipes installed along the edges of pavement and in some instances, where the groundwater is extremely high, underneath the pavements. The center of the subsurface drain should be placed no less than 1 ft below the level of the groundwater. When subgrade drains are installed along the edges of the pavement, they may also serve for draining the base course.

Intercepting drainage can be accomplished by means of open ditches well beyond the pavement areas. If this is not practical, then subdrains can be used.